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(54) IMPROVEMENTS IN OR RELATING TO ROTARY PISTON INTERNAL COMBUSTION ENGINES

(71) We, ROLLS-ROYCE (1971) LIMITED, a British Company, Norfolk House, St. James Square, London, SW1Y 4JR, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to rotary piston internal combustion engines provided with a combustion chamber external of the working cavities of the engine.

It is commonly found in rotary piston internal combustion engines of both the compression ignition and spark ignition types that the desirable features of the actual combustion spaces are so far compromised by the geometry of the stationary and rotating engine components as to fall far short of the ideal, and in so doing introduce considerable difficulties in fuel distribution, combustion control and exhaust emission.

According to the present invention a rotary piston internal combustion engine comprises first and second trochoidal rotary pistons having $n + 1$ sides which are respectively mounted within first and second trochoidal cavities having n lobes so as to define first and second sets of working chambers therewith, means for producing planetary rotation of the pistons in their cavities, means for permitting the supply of air to the second working chambers, means for permitting the withdrawal of exhaust gases therefrom, a first duct for transferring air which has been compressed in the second working chambers to the first working chambers for further compression therein, a second duct for transferring combustion gases which have been partially expanded in the first working chambers to the second working chambers for further expansion therein, a combustion chamber located remotely from the first and second sets of working chambers, first transfer duct means for transferring compressed air from the first working chambers to the combustion chamber and second transfer duct means for transferring combustion gases from the combustion chamber to the first working chambers for expansion therein.

The combustion chamber is preferably provided with fuel supply means and fuel igniter means.

For a better understanding of the invention and to show best how it may be carried into effect reference will now be made to the accompanying drawing, which diagrammatically illustrates a rotary piston internal combustion engine incorporating an embodiment of the present invention.

Referring to the drawing the rotary piston engine has two rotary pistons 10 and 11 which are respectively mounted on separate shafts 12, 13. The shafts 12, 13 are constrained to rotate run in the same angular sense at the same speed by means which are not shown but which may be constituted by gears, by a number of connecting rods running on eccentrics, by chains, or by any other suitable means. The pistons 10, 11 are respectively rotatable in a planetary manner in cavities 14, 15 formed in a stationary housing, the pistons being adapted to be rotated in phase with each other in the direction of the arrows 8.

The pistons 10, 11 have peripheral surfaces which includes three circumferentially spaced apex portions 10*a*, 11*a*, respectively, which are symmetrically arranged with respect to the axes of the pistons 10. 11. The apex portions 10*a*, 11*a*, have sealing edges 10*b*, 11*b* respectively which are respectively parallel to the shafts 12, 13 and which are at all times in sliding sealing engagement with the peripheral surfaces of the cavities

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14, 15 respectively. The peripheral surfaces of the cavities 14, 15 include two circumferentially spaced arched lobe defining portions 14*a*, 15*a*, respectively which are successively joined together and which provide at their junctions 21, 22 and 16, 17 points of minimum distance from the shafts 12, 13. Thus the peripheral surfaces of the cavities 14, 15 are substantially those of a two-lobed epitrochoid. The peripheral surfaces of the pistons 10, 11 are substantially those of the three lobed inner envelope of the two-lobed epitrochoid.

The piston 11 which is larger than the piston 10 and which is in sealing engagement with the cavity 15 defines with its cavity 15 three working chambers A B D according to the position of the piston 11. The working chambers may if desired be sealed from each other in known manner by sealing strips (not shown) at each of the three apex portions 11*b* of the piston 11. Additionally the sides of the pistons 11 may be provided with further sealing strips (not shown) which connect with the sealing strips at the apex portion 11*b*.

The piston 10 forms with its cavity 14 three working chamber F, G, H. The working chambers F, G, H, may be sealed from each other in a manner generally similar to that in which the working chamber A B D are sealed from each other.

Air may enter the engine through inlet port 23 and go via transfer ducts 25 and 35 to combustion chamber 36. Here the air flow through the combustion chamber 36 becomes mixed with fuel passing through conduit 37 and is ignited by means of igniter 38. The combustion gases then leave the combustion chamber 36 and enter the engine via transfer duct 39.

The various working chambers vary in both volume and position during the rotation of the pistons 10, 11, so that the working cycle is effected in which the air entering the cavities 14, 15 is compressed and the combustion gases therein expand.

The nature of the working cycle will become apparent from examinations of the drawing as it will be seen that the working chamber communicating with the inlet port 23 is increasing in volume as the rotors 10, 11, rotate in the direction of the arrows 8. A suction stroke is thus provided in which air is sucked through the inlet port 23.

The air which is sucked through the inlet port 23 is first subjected to a low pressure compression stage, and thereafter to a high pressure compression stage. During the low pressure compression stage some of the air being compressed is within the cavity 15 whilst some of it is within the cavity 14 having been transferred through duct 25. At the end of the low pressure compression stage, all the air being compressed is within the cavity 14. It will therefore be appreciated that the air received by the cavity 14 has been pre-compressed in passing through the cavity 15.

Combustion then takes place in the combustion chamber the high pressure air being fed to the combustion chamber 36 via transfer duct 35.

The expansion of the combustion gas then proceeds in two stages; a high pressure stage which occurs substantially wholly within the cavity 14, whilst the low pressure expansion stage occurs partly or wholly within the cavity 15, combustion gases passing from cavity 14, whilst the low via duct 26. Thus it will be appreciated that after the combustion gases partly expand within the cavity 14 they expand yet further within the cavity 15 before being exhausted through exhaust duct 24.

WHAT WE CLAIM IS:—

1. A rotary piston internal combustion engine comprising first and second trochoidal rotary pistons having $n+1$ sides which are respectively mounted within first and second trochoidal cavities having n lobes so as to define first and second sets of working chambers therewith, means for producing planetary rotation of the pistons in their cavities, means for permitting the supply of air to the second working chambers, means for permitting the withdrawal of exhaust gases therefrom, a first duct for transferring air which has been compressed in the second working chambers to the first working chambers for further compression therein, a second duct for transferring combustion gases which have been partially expanded in the first working chambers to the second working chambers for further expansion therein, a combustion chamber located remotely from the first and second sets of working chambers, first transfer duct means for transferring compressed air from the first working chambers to the combustion chamber and second transfer duct means for transferring combustion gases from the combustion chamber to the first working chambers for expansion therein.

2. An engine as claimed in claim 1 in which the combustion chamber is provided with fuel supply means.

3. An engine as claimed in claim 2 in which the combustion chamber is provided with fuel igniter means.

4. A rotary piston internal combustion engine constructed and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

For the Applicant.
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